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Young Children's Help-Seeking as Active Information Gathering

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Abstract

Young children's social learning is a topic of great interest. Here, we examined preschoolers' (M = 52.44 months, SD = 9.7 months) help-seeking as a social information gathering activity that may optimize and support children's opportunities for learning. In a toy assembly task, we assessed each child's competency at assembling toys and the difficulty of each step of the task. We hypothesized that children's help-seeking would be a function of both initial competency and task difficulty. The results confirmed this prediction; all children were more likely to seek assistance on difficult steps and less competent children sought assistance more often. Moreover, the magnitude of the help-seeking requests (from asking for verbal confirmation to asking the adult to take over the task) similarly related to both competency and difficulty. The results provide support for viewing children's help-seeking as an information gathering activity, indicating that preschoolers flexibly adjust the level and amount of assistance to optimize their opportunities for learning.

Keywords: Help-seeking; Active learning; Information gathering; Social learning; Scaffolding; Preschoolers

1. Introduction

In the past two decades researchers have shown substantial interest in young children's social learning. This interest derives from a variety of disciplines, including education (Aleven & Koedinger, 2002; Arterberry, Cain, & Chopko, 2007; Newman, 2000; Roll, Aleven, McLaren, & Koedinger, 2011; Ryan & Shin, 2011), developmental psychology (Gauvain, 2005; Gergely & Csibra, 2013; Gopnik & Wellman, 2012; Harris, 2012; Paradise & Rogoff, 2009; Sobel & Kushnir, 2013; Tomasello, 2008), computer science (Breazeal & Scassellati, 2002; Kim et al., 2013; Oudeyer & Kaplan, 2006), and neuroscience

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(Brown & Brune, 2012; Gariepy et al., 2014; Porges, 2007; Siviy & Panksepp, 2011; Syal & Finlay, 2011). The resulting findings on children's powerful, early-emerging social learning faculties and abilities have led some researchers to argue that social learning faculties are primarily what differentiate humans from non-human primates (Gergely & Csibra, 2013; Tomasello, 2008).

Research has documented both benefits and costs of children's receptivity to social information and assistance during learning. On one hand, social learning has clear benefits to children. For example, children's receptivity to direct pedagogy helps them acquire conceptual knowledge that cannot be directly experienced (Harris, 2012; Harris & Koenig, 2006; Keil, 2010; Sobel & Kushnir, 2013). Moreover, even when children do have opportunities to learn from their own exploration and play, adults can play a supportive roll through scaffolding—that is, monitoring the child's activity to provide the appropriate amount (i.e., not too much nor too little) and type (e.g., instruction, modeling examples) of feedback (Vygotsky, 1978). Children's receptivity to this type of assistance supports social development (Clark, Menna, & Manel, 2013; Gauvain, 2005), cognitive development (Murphy & Messer, 2000; Whitehurst et al., 1988), and self-regulation (Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012).

On the other hand, social information and assistance may at times be restrictive rather than beneficial for learning. Evidence from another body of developmental research and theory highlights the benefits of children's independent active learning and exploratory play (Bonawitz et al., 2011; Hirsh-Pasek & Golinkoff, 2011; Lillard, 2005; Schulz, 2012; Schulz & Bonawitz, 2007). This research shows that, without direct pedagogy or adult intervention, preschoolers' free play supports powerful forms of learning about objects, events, and causality. Critically, this research shows that pedagogical instruction from adults can mitigate the benefits of children's independent exploration. For example, Bonawitz et al. (2010) analyzed children's exploratory play with a complex, multi-faceted toy after an adult demonstrated one function pedagogically, demonstrated one function non-pedagogically, and at baseline. Children limited their exploratory play to the single demonstrated function following the pedagogical demonstration but explored broadly in the other conditions and thereby discovered other functions. Hence, while adult involvement often highlights important information, it also curbs children's exploratory discovery of novel information.

Here, we offer a possible way to reconcile these disparate findings. Rather than focusing on the child's *receptivity* to social information and assistance, we ask whether young children engaged in a task *actively seek* adults' help in a balanced manner that supports their learning. Importantly, rather than emphasizing the adults' role in social scaffolding, this study focuses on whether young children themselves seek assistance when in need, but act independently when not in need. By framing this question, we ask whether young children's social active learning is driven by their exploration of the world, similar to non-social forms of active learning.

In this way, the present research systematically examines whether young children's help-seeking can be profitably analyzed in terms of the information gathering trade-offs children face in acting independently versus seeking assistance. From an information

gathering perspective, research suggests that children encode information better after acting than after watching someone else perform an action (Berry, 1991; Duran & Gauvain, 1993; Sommerville, Hildebrand, & Crane, 2008) and, further, may learn from others' actions when those actions are erroneously encoded as having been self-produced (Sommerville & Hammond, 2007). Also, research on causal learning demonstrates that preschoolers often prefer evidence they produce over evidence they watched another person produce (Kushnir & Gopnik, 2005; Kushnir, Wellman, & Gelman, 2009). Thus, according to an information gathering analysis, when children are able to do something by themselves, they may learn best when acting themselves as opposed to ceding the activity to others. Of course, children would gain little or no information by acting independently if independent action led to *no* new information. Thus, when a child is cognitively or motorically unable to perform an activity, he/she should seek assistance instead of struggle alone.

Table 1 depicts these hypotheses in a payoff matrix of what children should do to maximize information gathering. (Children's competency and the cognitive and motoric difficulty of activities vary continuously, but here we introduce them in a simplified discrete manner.) As Table 1 shows, for a child who is competent in the activity, independent action provides a better opportunity for learning than seeking assistance, unless the activity is quite difficult, in which case a mixture of independent action and assistance is best. For a somewhat competent child, independent action is optimal for simple parts, a mixture for moderately difficult parts, and assistance for difficult parts. Lastly, for an incompetent child, seeking assistance provides the best means of learning, except in simple parts, which are best approached with a mix of assistance and independent action.

The definition of help-seeking we use in our method below is consistent with that of prior work on older children's help-seeking in formal academic settings (Nelson-Le Gall, Kratzer, Jones, & DeCooke, 1990; Nelson-Le Gall & Glor-Scheib, 1986; Newman, 2000; Ryan & Shin, 2011; Thompson, Cothran, & McCall, 2012). For instance, in third and fifth graders it has been found that help-seeking is more likely to occur when an individual expresses a lack of confidence in his or her ability to independently complete the task (Nelson-Le Gall et al., 1990). In school-age children, requests for assistance can result in a range of exchanges of information and action. In particular, responses include indirect

Table 1
Discrete outline between task difficulty and child competency from an information gathering account

	Simple Activity	Somewhat Difficult Activity	Difficult Activity
Competent child	$I - c_1 > C - c_2$	$I - c_1 > C - c_2$	$\frac{1}{2}[(I - c_1) + (C - c_2)]$
Somewhat competent child	$I - c_1 > C - c_2$	$\frac{1}{2}[(I - c_1) + (C - c_2)]$	$C - c_2 > I - c_1$
Incompetent child	$\frac{1}{2}[(I - c_1) + (C - c_2)]$	$C - c_2 > I - c_1$	$C - c_2 > I - c_1$

Note. This table represents a payoff matrix of our hypotheses in discrete form. The entries represent what sorts of action, independent or collaborative, best support children's learning. I = independent action, C = collaboration, and c represents the cost associated with the action. The cost could represent energy expenditure or risk, which in this and most other cases do not substantially differ, but they could, leading to different predictions.

verbal hints that facilitate the help-seeker, direct coordination of actions between the help-seeker and helper, and task completion by the helper (Newman, 2000). Of particular relevance to this study, and consistent with the information gathering framework described, elementary school students often prefer indirect (i.e., hints) to direct help (i.e., solutions), indicating a preference to remain involved in the activity (Nelson-Le Gall & Glor-Scheib, 1986). Thus, research with older children in classroom settings indicates help-seeking generally occurs in relation to explicitly stated uncertainty about independently carrying out tasks, and it can lead to a variety of exchanges of information and action between the help-seeker and helper.

The question of whether even younger children would seek help in a systematic relation to their own knowledge and abilities remains open. With older children in formal settings, it is complicated to isolate individual factors as causes of children's help-seeking behavior from classroom factors. Classroom settings often include conventions and instructions on when and how to engage others and ask for help, as well as peer social environments known to influence children's help-seeking at these ages (Newman, 2000). In addition, studying younger children enables us to ask whether our theoretical framework is a potentially useful description of young children's *implicit* help-seeking, even while their ability to explicitly monitor their own knowledge and uncertainty is still emerging (Ghetti, Hembacher & Coughlin, 2013; Lyons & Ghetti, 2011). We therefore chose to study preschoolers, specifically children aged 3 years and 6 months to 5 years and 6 months. Help-seeking and active learning are common among preschoolers, which suggests that they are early-emerging behaviors that are present without and before formal training (Gopnik, 2012; Newman, 2000). Relatedly, much recent research on young children's help-seeking, social learning, and active learning has focused on preschoolers (Bonawitz et al., 2011; Cluver, Heyman, & Carver, 2013; Duran & Gauvain, 1993; Foley & Ratner, 1998; Foley, Ratner, & House, 2002; Hammond et al., 2012; Rogoff, 1990; Schulz & Bonawitz, 2007; Sommerville & Hammond, 2007). This research therefore examines preschoolers to avoid complications related to classroom training and to investigate fundamental features of children's early emerging help-seeking.

To reiterate, the fact that children can and do ask for help on difficult tasks may seem obvious, but an open question remains. How flexible are they in doing so? Here we assess the idea that children seek help in a way that mirrors high-quality adult scaffolding. We designed an activity with multiple steps, on each of which children could choose to act independently or seek assistance. The activity was a toy assembly task, similar to Sommerville and Hammond (2007), in which children assembled a structure out of parts, step-by-step, by following instructive pictures.

Prior to the experimental task, we trained children on how to use the instructions to assemble a toy. We then asked them to construct a toy independently, comparable to the one used in the experimental task, without assistance. Their ability to construct this toy served as an estimate of their initial competence. Also, we randomly assigned a separate group of children to construct all of the toys (training, assessment, and experimental task toys) without help available. This group's average success at completing each step of the assembly was used as an estimate of the step's difficulty.

Consistent with prior research on help-seeking and as described in the Method, we adopted the standard that in order for an event to be described as help-seeking, the child needed to signal a desire for assistance via verbalization, extended eye contact, gesture, or a combination of these behaviors. Children's behavior was then coded as independent action or help-seeking. We further coded all help-seeking events in terms of the level of assistance requested, which could range from a request for verbal feedback on a completed step all the way to a request for the experimenter to perform the assembly of that step.

Taking into account individual children's initial competence, as well as the difficulty of each step of the task, we predicted that children would engage with the helper only to the extent (and to the degree) that children needed help. In this way, children implicitly make use of social resources to actively scaffold their own learning.

2. Experiment 1a

2.1. Method

2.1.1. Participants

Participants were 40 preschoolers (M = 52.44 months, SD = 9.7 months; 21 females). Children were recruited from preschools and also from a database of research participants whose parents expressed interest in participating in research at the time of the child's birth. The children were all from the surrounding region of a rural university town and were predominantly Caucasian and middle and working class. All participants were native English speakers. Three additional children were excluded from the final sample; one due to experimenter error, one due to uncooperativeness, and one due to interruption of the experiment.

2.1.2. Stimuli

The stimuli were Edushape Interstar rings. In the current experiment, numerous rings were connected with one another so as to resemble larger objects. Children were shown laminated instructive pictures depicting each step of construction for four different toys (see Fig. 1). The four toys consisted of the Warm-up Toy (termed the Key), the Assessment Toy (termed the Boat), and the two Test Toys (termed Sally and Sally's House). At least one, and sometimes two, toy pieces were added to the structure at each step. The photographs for each toy were ordered for the child, from first to last, on a picture stand facing the child.

2.1.3. Apparatus

Play sessions occurred at a child-sized table in a quiet room in the laboratory or in a quiet room in the child's preschool. The child sat on one side of the table next to the experimenter. The interactions were recorded with two Sony DCR-SR68 digital cameras. One camera was positioned at the side of the table, capturing the experimenter, the child,

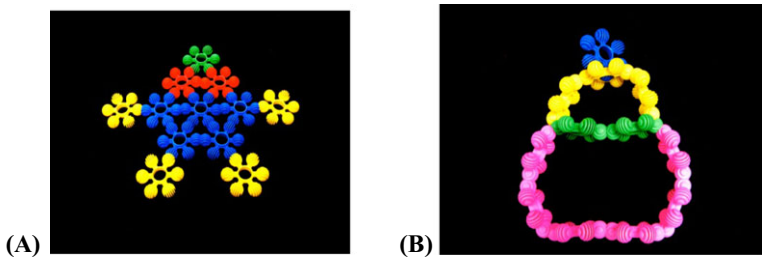

Fig. 1. The child was shown laminated pictures depicting the step-by-step construction of the Warm-up Toy, the Assessment Toy, and the two Test Toys, Sally (A) and Sally's House (B), shown here.

and the toy pieces. The second camera was positioned facing the child to capture the child's visual attention and movements.

2.1.4. Procedure

2.1.4.1. Warm-up toy: The Warm-up Toy was completed to teach children how to manipulate the toy pieces and make them look like the instructive pictures. The experimenter told the child that they had some toys and some pictures, and they could make the toys look like the pictures. The experimenter told the child to watch her as she completed the first step. After completing the first step, the experimenter asked the child, "Does that look like the picture?" If the child said no, the experimenter explained that the color, position, and number of pieces all made it look like the picture. The child and experimenter then took turns making the Key. Corrective feedback was given for mistakes.

2.1.4.2. Assessment toy: Next the child completed an Assessment Toy, termed the Boat, which provided a graded assessment of the child's competence in independently constructing the toys as shown in the instructive pictures. The experimenter presented the child with the pictures of the Boat. The experimenter asked the child to do the Boat independently, saying, "You can do this one by yourself by making it look like the picture. Start with the first picture. Each time you need a new picture, just move the picture. Now go ahead and make it look like the picture." As the child completed the Boat, the experimenter expressionlessly watched the child. If the child commented about their progress or asked for assistance, the experimenter said, "Now try to make it look like the picture" and "Remember, you do the Boat by yourself." The experimenter did not provide any corrective feedback.

The child had up to 5-min time to complete the Boat. Following the 5 min, the experimenter asked the child the Accuracy Awareness Question, saying, "We are all done with the Boat. Now let's take a look. Does that [pointing at the child's final product] look like the picture [pointing at the Boat's final picture]?" The child's first answer, yes or no, was recorded as their response. If children were unsure, they were asked to choose yes or no. If the child was inactive for 30 consecutive seconds before 5 min lapsed, the experimenter asked the child, "Are you done with the Boat?" If the child affirmed that

they were, then the experimenter asked the Accuracy Awareness Question, as defined above.

2.1.4.3. Test toys: To determine whether the child's competence related to their help-seeking, the child then completed the two Test Toys, Sally and Sally's House. Twenty-two of the children were randomly assigned to the Help-Seeking Group and eighteen to the No Help Group without knowledge of their competence. In both the Help-Seeking Group and the No Help Group, half of the children did Sally first and half did Sally's House first. Children had as long as needed to finish the Test Toys.

In the Help-Seeking Group, the experimenter looked at the child and said, "Now I can help you make Sally, so just let me know when you want me to do some, OK? So if you want help, I'm right here." The experimenter, still sitting next to the child at the child-sized table, sat and watched, and did not intervene or provide any sort of verbal feedback unless the child sought assistance (see "Help-Seeking Responses" below for details on how the experimenter responded to bids).

In the No Help Group, the experimenter said, "You can do this one by yourself by making it look like the picture. Now go ahead and make it look like the picture." The experimenter sat quietly in the same position as for the Help-Seeking Group and watched the child complete the toy. The experimenter did not intervene or provide any sort of verbal feedback, and responded to requests for assistance as in the Assessment Toy.

In both conditions, upon the child's completion of Sally and Sally's House, the experimenter asked the Accuracy Awareness Question, saying, "Wow that was the last picture! We are all done with [Sally or Sally's House]! Now let's take a look. Does that [pointing at the child's final product] look like the picture [pointing at the toy's final picture]?" Again, the child's first response was coded as their answer.

2.1.4.4. Help-seeking bids: Based on prior work and our own pilot observations in preschools, children seek assistance with adults and other children by establishing eye contact, remarking that the activity is difficult, and directly asking for assistance. We therefore coded these forms of help-seeking bids in the Help-Seeking Group. Accepted eye contact bids consisted of the child either (a) making at least 2 s of eye contact with the experimenter (i.e., the experimenter counted the seconds) and then looking at the toy or (b) making eye contact with the experimenter for at least 1 s, looking at the toy, and making another second of eye contact with the experimenter. Accepted verbal bids consisted of (a) remarks about having difficulty and (b) requests for assistance. The experimenter responded to acceptable eye contact and remarks of difficulty by asking, "Do you want me to help?" If the child declined assistance, no assistance occurred. If the child assented, the experimenter provided assistance. The experimenter responded to direct requests for assistance by assisting the child instead of asking whether they wanted help first.

2.1.4.5. Limits of assistance: The experimenter always provided helpful, unhesitating, and accurate assistance with a single step of the toy construction task, unless the child

asked for further assistance on the following step. If the child asked the experimenter not to intervene further, the experimenter stopped helping. If the child had made mistakes in steps prior to the one at which they asked for assistance, the experimenter aided in correcting the past mistakes. In this way, the experimenter did not condone errors, functioned as an ecologically valid adult helper, and avoided the potential complication of inconsistent experimenter responses across children to vague requests for assistance.

2.1.4.6. Help-seeking responses: If the child structured the experimenter's response by specifying a particular motoric or cognitive difficulty, the experimenter addressed the particular problem. For example, if the child was struggling to fit two pieces together and commented that it was difficult to put them together, the experimenter assisted the child in pushing them together. In this case, both the child and experimenter would be involved in physically fitting them together. On the other hand, if the child simply asked if one piece went on top of the other, the experimenter provided the information and permitted the child to physically carry out the actions. In response to vague requests for assistance without child action, for instance looking at the step and stating, "This is too hard," the experimenter gathered the correct pieces, carried out the step, and provided an explanation. Likewise, if the child simply asked for verbal clarification, the experimenter's response was limited to verbal clarification. In this way, the experimenter's assistance was contingent upon the extent to which the child structured it.

2.1.5. Coding

2.1.5.1. Children's competency (Assessment toy—The boat): To quantify children's need for information, we assessed children's competency in constructing the Assessment Toy. Each child's competency was quantified in a Competency Score. The Competency Score consisted of five parameters that assessed for each step of the toys whether the child: (1) added the correct number of pieces, (2) made the correct number of connections with those pieces, (3) made the correct type of connection(s), (4) added pieces of the correct color(s), and (5) connected the pieces to the correct part of the existing structure. For each step, children earned from 0 to 5 points; each parameter was worth a minimum of 0 and a maximum of 1 point. Partial credit (e.g., ½ points) was given for partial completion. Children's performance score on each step of the Assessment Toy therefore had a minimum of 0 and a maximum of 5 multiplied by the toy's number of steps (8 steps; range 0–40). The Competency Scores were assessed and computed by hypothesis-blind coders after testing for the experiment had finished.

2.1.5.2. Children's performance on the test toys (Sally and Sally's house): The same coding as above was used to assess children in the Help-Seeking Group as they completed the Test Toys. Once again, children's performance score for each Test Toy had a minimum of 0 and a maximum of 5 multiplied by the toy's number of steps (10 steps each; range 0–50).

2.1.5.3. Step difficulty of the test toys (Sally and Sally's house): The No Help Group's competency on each step of the Test Toy construction was used as a means of computing baseline difficulty of the Test Toys' steps. The scoring was the same 0 to 5 scale that was used to measure Competency Scores on the Assessment Toy. But this time we did not sum across steps; instead we used the average competency of the No Help Group at each step as an index of step difficulty in our analysis (below). Since the step difficulty scores were computed after the experiment was completed, the experimenter was not aware of the step difficulty scores.

2.1.5.4. Help-seeking initiated?: A binary response was coded for each step on which children in the Help-Seeking Group requested assistance. Reliability coding performed on 55% of the sample indicated high reliability ($r = .97$, $p < .01$; $\kappa = .97$, $p < .01$).

2.1.5.5. Level of assistance: For the Help-Seeking Group, the social interactions following children's help-seeking bids at each step were rank-ordered in five categories from the lowest to the highest levels of assistance: (0) no assistance, (1) the child performed the action and the experimenter provided verbal feedback about the child's action, (2) the child provided information about how the pieces assemble and the experimenter performed the action, (3) both the child and the experimenter provided information about how the pieces are assembled and both were involved in assembling them, and (4) the experimenter performed the actions and provided the information about how the pieces are assembled. If multiple levels of assistance were present during one step, the step was coded by the highest level present. Reliability coding performed on 55% of the sample indicated high reliability ($r = .90$, $p < .01$; $\kappa = .73$, $p < .01$).

2.1.5.6. Children's statements and visual attention: As mentioned above, help-seeking bids were initiated by eye contact and children's requests for assistance and remarks of difficulty. We coded and summed the number of help-seeking statements children made on each step. We also coded the number of seconds children spent visually attending to the materials and to the experimenter, and summed them for each step of each toy. We then computed the proportion of time children attended to the experimenter over the total time the child spent on the step of each toy.

2.1.5.7. Accuracy awareness question: To assess children's awareness of their own accuracy and/or inaccuracy, children were asked whether their final product "looked like" the final picture of each toy. Their responses were coded as "yes," "no," and, if they declined to choose one of these, "I don't know."

2.2 Results

2.2.1. Children's competency

Overall, on the Assessment Toy children averaged a Competency Score of 29.83 of 40 with a standard deviation of 10.49. There were no systematic differences in competency

between children in each group (Help-Seeking: $M = 30.17$, No Help: $M = 29.84$, $t(38) = .591$, $p = ns$). Thus, our sample of children displayed sufficient variation in competency to further investigate our hypotheses.

2.2.2. Order effects

We conducted analyses to ensure that children's performance and help-seeking did not differ as a matter of the temporal order in which children constructed the Test Toys, Sally and Sally's House. Paired t tests indicated that the Help-Seeking Group's performance was not significantly related to the order of the toys (Sally first: $M = 44.8$, Sally second: $M = 40.7$; $F = 1.584$, $p = .224$; Sally's House first: $M = 44.85$, Sally's House second: $M = 41.66$; $F = 3.545$, $p = .076$). Additional paired t tests indicated that the number of steps on which children sought assistance did not differ as a matter of the order in which children constructed Sally (Sally first: $M = 2.8$, Sally second: $M = 1.2$; $t = 1.652$, $p = .133$; Sally's House first: $M = 2.0$, Sally's House second: $M = 1.6$; $t = .647$, $p = .534$). Subsequent analyses therefore collapse across order.

2.2.3. Help-seeking initiated?

We predicted that children would seek assistance when they were unable to perform the activity independently, and conversely that they would not seek assistance when they could construct the toys independently. Our principal analysis therefore assessed whether the difficulty of the Test Toy steps, as measured by the No Help Group's average performance, and children's competence, as measured by children's Competency Scores, predicted children's choices to seek assistance. Specifically, we expected that as the difficulty increased and children's competency decreased, children would be more likely to seek assistance, as depicted in Table 1.

2.2.4. Logistic regression analyses

In assessing our predictions of children's help-seeking, we needed to properly account for the dependence among children's repeated measurements at each step. We therefore employed a general estimating equation (GEE), which is a common form of logistic regression analysis, with children as the repeated effect. Our first dependent variable was the binary variable: whether children selected to seek assistance on each step (1 = yes, 0 = no). We first performed an analysis with step difficulty and children's Competency Scores as the two predictors. The logistic regression analyses were carried out with PASW Statistics version 18 (2009) in a Windows 7 environment. This analysis revealed that both step difficulty and children's Competency Scores were significant predictors of children's choices of whether to seek assistance (Step difficulty: $\beta = .829$, Wald's $\chi^2 = 33.073$, $p = .000$; Competency: $\beta = -.088$, Wald's $\chi^2 = 26.131$, $p = .000$). This indicates that when the step was more difficult and the child less competent, children were significantly more likely to seek assistance than act independently. Similarly, when the steps were simple and the child competent, children were more likely to act independently.

We next performed a second analysis with the GEE that included other possible predictors of help-seeking behavior. Children's gender may be a factor, so we included

gender (female = 0, male = 1). As it was possible that help-seeking behavior differed as a matter of the structure of the toys, we included the toy (Sally = 0, Sally's House = 1). The three predictors were step difficulty, children's Competency Scores, and age. We included age because it was possible that children sought assistance more or less as they aged. According to the model, the log of the odds of a child seeking assistance remained significantly positively related to step difficulty ($p = .000$) and significantly negatively related to children's competence ($p = .001$; Table 2). As depicted in Table 2, neither age, gender, nor the particular toy related to children's help-seeking. Thus, the analyses again indicated that children's help-seeking was indeed related to the difficulty of the activity and children's ability to independently execute the activity.

However, we were concerned that the order of the steps could relate to children's help-seeking and be a hidden factor of step difficulty. Specifically, it was possible that children selected to seek assistance more as they became tired of the activity as opposed to the difficulty of the steps. Similarly, given that the experimenter corrected children's past mistakes, it was also possible that children may have sought assistance more on the later steps simply to obtain this benefit. To address these possibilities, we performed a third GEE analysis with toy step and step difficulty as the predictors, and help-seeking as the dependent variable. Step difficulty was a statistically significant predictor of help-seeking, but toy step was not (Step difficulty: $\beta = .717$, Wald's $\chi^2 = 20.345$, $p = .000$; Step: $\beta = -.003$, Wald's $\chi^2 = .017$, $p = .896$). This result helped to specify that step difficulty, as opposed to the order of the toy steps and/or ordering of the toys, related to children's help-seeking.

2.2.5. Theoretical model

These logistic regression results are consistent with our hypothesis that children requested assistance as an information gathering activity, that is, when they were unable to independently complete the activity. However, while the logistic regression analyses were statistically significant, it was still possible that children did not behave in a manner

Table 2
Logistic regression analysis of children's choices to seek help per step: Performed by PASW, version 18

Predictor	β	*SE* β	Wald's χ^2	*df*	*P*	Odds Ratio
Constant	6.005	2.8820	4.341	1	.000***	405.482
Toy	−.050	.3396	.022	1	.886	.951
Gender	.001	.7266	.000	1	.895	1.001
Step difficulty	.837	.1392	36.180	1	.000***	2.310
Competency	−.077	.0238	10.393	1	.001***	.926
Age	−.413	.6246	.438	1	.508	.662

Notes. This table shows the results of the parameter estimates for a logistic regression analysis performed with a general estimating equation. The model assesses which variables relate to children's choice to collaborate or act independently. Toy (Sally = 0, Sally's House = 1) and gender (female = 0, male = 1) were entered as factors. Step difficulty, competency, and children's age were entered as covariates.
***Indicates statistically significant at the .001 level.

reflective of our model. In other words, the logistic regression analyses indicated children's behavior was statistically consistent with our hypotheses, but not directly consistent with our predictions depicted in Table 1, which is a more stringent criterion. To assess the latter point, we also desired a categorical depiction of children's observed behavior to compare with our theoretical model in Table 1.

To determine whether children indeed acted in a manner consistent with Table 1, we had to compare children's observed actions with the output of a model consisting of Table 1's two factors: children's competencies and the step difficulties. If children's observed help-seeking behavior was similar to the output of a model consisting solely of children's competency and the step difficulties, it would indicate that children chose to seek help largely as a function of those two factors alone.

To replicate the matrix of Table 1, we needed to divide the children and the steps into three groups reflecting the categories of Table 1. Our sample of children proved to be skewed toward Table 1's Competent category, with few members representing the Not Competent and Somewhat Competent categories. That is, a majority of children had a Competency Score in the range of 35–40 out of a maximum of 40, with only one child scoring below 10. (This skew did not alter our theoretical model or predictions; rather, it indicated that this analysis of our model would be limited to the more competent range of Table 1.) In light of the observed skew in competency, we modified our table to consist of the following categories of Competency Scores: Less Competent (0–20), More Competent (21–35), and Very Competent (36–40). The Less Competent category consisted of four children, the More Competent category of five children, and the Very Competent category of twelve children. Four children in the Very Competent category achieved perfect Competency Scores, indicating they were capable of independently constructing the toys.

Similarly, the steps were skewed toward the Simple category of Table 1. For each step, children could score a maximum of 5 and a minimum of 0. The lowest step score was 1.87, and the majority of step scores were above 3.5. To account for the lack of difficult steps, we defined the following three categories of step difficulty: Simple (0–1.0), Somewhat Difficult (1.1–2.0), and More Difficult (2.1–5). The Simple category consisted of eleven steps, the Somewhat Difficult category of five steps, and the More Difficult category of three steps.

On the basis of these categories of Competency Scores and step difficulties defined above, we computed the observed probability of help-seeking for each matrix cell. These probabilities are displayed in Table 3. Importantly, for each cell help-seeking was more likely as the difficulty of the steps increased and competency scores decreased. This result was consistent with our theoretical model's predictions. As stated, the relatively high competencies of the children, along with the relatively simple nature of the stimuli, led us to predict that they would seek assistance less often than indicated by Table 1. This result is also observed in Table 3.

We were unable to assess a GEE model based on categorical variables representing the groups because some of the cells would contain 0 (the less competent group's children sought help on all of the more difficult steps). Instead, we next assessed how our

Table 3
Cumulative logistic regression analysis of children's level of assistance: Performed by PASW, version 18

Predictor	β	*SE* β	Wald's χ^2	*df*	*p*	Odds Ratio
Constant (Level = 0)	−2.760	2.2798	1.466	1	.226	.063
Constant (Level = 1)	−2.284	2.2750	1.008	1	.315	.102
Constant (Level = 2)	−1.862	2.2969	.657	1	.417	.155
Constant (Level = 3)	−.787	2.2735	.120	1	.729	.455
Toy	−.150	.3907	.147	1	.702	.861
Gender	−.064	.6582	.010	1	.922	.938
Step difficulty	.940	.1544	37.038	1	.000***	2.559
Competence	−.108	.0159	45.813	1	.000***	.898
Age	−.413	.4862	.722	1	.395	.655

Notes. This table shows the results of the parameter estimates for a cumulative logistic regression analysis performed with a general estimating equation. The model assesses which variables are predictive of the character of children's collaboration. Toy (Sally = 0, Sally's House = 1) and gender (female = 0, male = 1) were entered as factors. Step difficulty, competency, and children's age were entered as covariates. The levels of collaboration, described above, refer to different categories and magnitudes of collaborative interactions.
***Indicates statistically significant at the .001 level.

statistical GEE model's predictions, based on the continuous values of competency and step difficulty, compared with our observed probabilities. Critically, this provides evidence as to how well the occurrence of children's help-seeking coheres with the two factors in our theoretical model: step difficulty (represented by "D" below) and competency (represented by "C" below). We first needed to select covariate values that were representative of the three competency categories and three step difficulty categories outlined in Table 3. We selected the means of the observed values of each category (represented by "M" below) to be the representative covariate values. We then computed the statistical model's probability of seeking assistance using the parameter estimates provided by the above-described GEE analysis. This consisted of applying the following equation:

$$P = e^{\text{Constant} + \text{D}*\text{M}}\text{D} + \text{C}*\text{M}\ \text{C}/(1 + e^{\text{Constant} + \text{D}*\text{M}}\text{D} + \text{C}*\text{M}\text{C})$$

The results are displayed in Fig. 2B.

Figs. 2A and B, that is, the observed and computed probabilities of children seeking help on a given step, are remarkably similar. The congruence of the cell values and the direction of change across cells augment the logistical regression analyses by providing a direct demonstration that children's behavior was consistent with our predictions modified for the observed skews in children's Competency Scores and the step difficulties. Most important, these analyses suggest a large portion of young children's choices to seek assistance may be a function of two factors: children's competency and the difficulty of the activity.

2.2.6. Levels of assistance

Thus far, our analyses indicated that children's Competency Scores and the step difficulties were predictive of when children decided to seek assistance. We also investigated

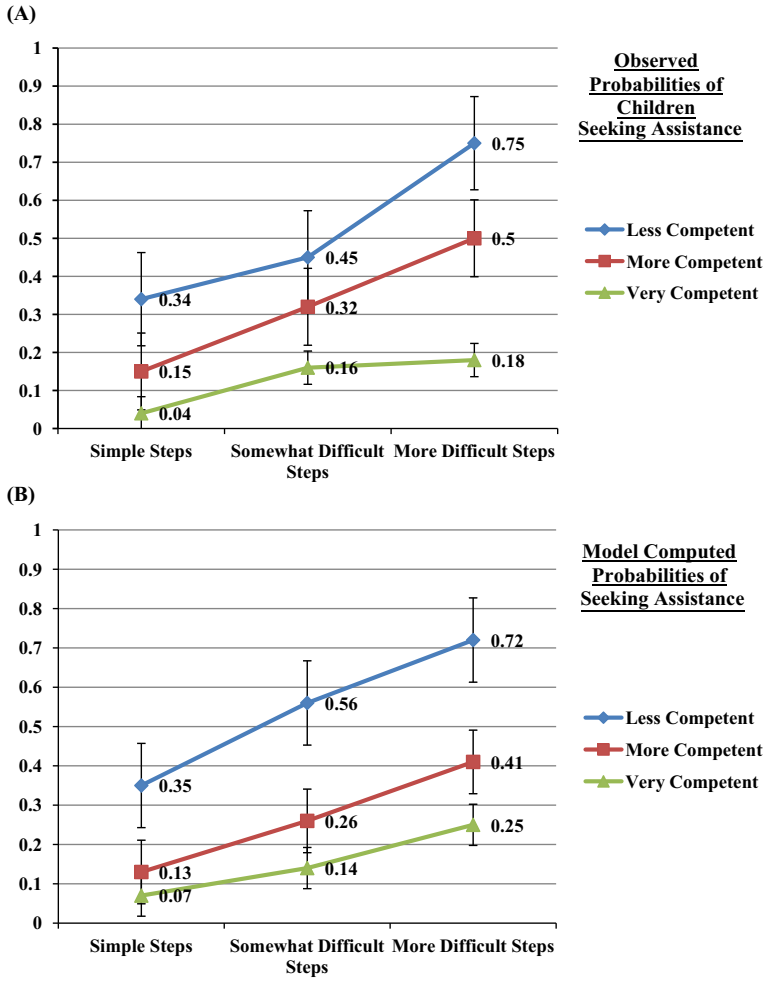

Fig. 2. (A) Children were categorized into three competency categories and the toy steps into three difficulty categories. The graph shows children's observed probability of collaboration for each category of children and steps. Standard error bars are displayed. (B) As outlined in the text, three categories of child competency and step difficulty were defined. The probability of collaborating was then computed from our logistic GEE model consisting of step difficulty and competency. Standard error bars are displayed.

whether the character of the social interactions differed as a matter of difficulty and children's competence. We performed a multinomial distribution GEE in which the dependent variable was the level of assistance, with no assistance being level 0. By including 0 as no assistance, we ensured that each step of both Test Toys was included. The toy (Sally = 0, Sally's House = 1) and children's gender (female = 0, male = 1) were the factors. The three predictors were step difficulty, children's Competency Scores, and children's age. The resulting analysis indicated that the log of the odds of raising the level of assistance was significantly positively related to step difficulty (p = .000) and

significantly negatively related to children's competence ($p = .000$; Table 3). This indicates that the social interactions tended to involve more action and information sharing from the adult experimenter as the difficulty of the steps rose and children's Competency Scores decreased. Neither age nor any of the factors related to the character of children's help-seeking interactions. This analysis furthers our understanding by suggesting that not simply the occurrence of help-seeking but also the action coordination of the resulting social interactions relate to the difficulty of the activity and children's ability to independently execute the activity.

Again, it was possible that children involved the experimenter more because of fatigue of the activity as opposed to step difficulty. In addition, it was possible that children selected to seek help more on later steps to take advantage of the fact that the experimenter corrected children's past mistakes. We therefore performed another analysis to evaluate whether differences in the character of children's social interactions resulted from the order of the steps as opposed to step difficulty. The regression indicated that step difficulty, not the order of steps, related to the character of children's social interactions (Step difficulty: $\beta = .744$, Wald's $\chi^2 = 20.989$, $p = .000$; Step: $\beta = .015$, Wald's $\chi^2 = .228$, $p = .633$). This provided further evidence that the difficulty of the activity, as opposed to some other aspect inherent in the order of steps, related to the manner in which children sought assistance.

2.2.7. Children's statements and visual attention

The above-described results formed the primary assessment of the idea that help-seeking can function as an information gathering activity for children. Our data also enabled analysis of how children behaviorally initiated and structured the social interactions. We employed logistic and linear GEE models with children as the repeated effect to analyze children's visual attention and verbal statements on the Test Toys. Our three dependent variables for the following analyses were (1) the proportion of time children spent looking at the experimenter on a step, (2) how many seconds they spent completing a step, and (3) the number of help-seeking statements children made on a step.

2.2.7.1. Help-seeking group: For the Help-Seeking Group, time spent on each step increased significantly with step difficulty (Step difficulty: $\beta = 14.708$, Wald's $\chi^2 = 27.381$, $p = .000$), and decreased marginally with children's competence (Competence: $\beta = -.739$, Wald's $\chi^2 = 3.262$, $p = .071$). Regarding children's visual attention, the proportion of time children spent looking at the experimenter on a step decreased significantly as children's competence increased (Competence: $\beta = -.047$, Wald's $\chi^2 = 9.832$, $p = .002$), but it increased with step difficulty to a marginally significant degree (Step difficulty: $\beta = .257$, Wald's $\chi^2 = 2.683$, $p = .101$). Similarly, the number of help-seeking statements children made per step decreased significantly as children's competency increased (Competence: $\beta = -.058$, Wald's $\chi^2 = 18.693$, $p = .000$), and significantly increased as step difficulty increased (Step difficulty: $\beta = .732$, Wald's $\chi^2 = 40.165$, $p = .000$). Thus, together these analyses indicate children spent more time on steps as the gap between their competency and the competency needed to complete

the step increased. Using both visual attention to the experimenter and help-seeking verbal statements, children involved the experimenter to overcome challenges.

2.2.7.2. No help group: For the No Help Group, time spent on each step increased significantly with step difficulty (Step difficulty: $\beta = 17.111$, Wald's $\chi^2 = 16.631$, $p = .000$) and decreased at a statistically marginal level as children's competency increased (Step difficulty: $\beta = -.446$, Wald's $\chi^2 = 2.607$, $p = .106$). Neither step difficulty nor competency related significantly to the proportion of time children spent looking at the experimenter on a step (Step difficulty: $\beta = .095$, Wald's $\chi^2 = .398$, $p = .528$; competency: $\beta = -.032$, Wald's $\chi^2 = 1.426$, $p = .232$). In addition, the number of help-seeking comments on the Test Toys was not significantly related to children's competency (Competence: $\beta = -.003$, Wald's $\chi^2 = .009$, $p = .925$), but it was significantly related to step difficulty (Step difficulty: $\beta = -.596$, Wald's $\chi^2 = 6.483$, $p = .011$). These analyses indicate that, similar to the Help-Seeking Group, children in the No Help Group spent more time on the steps as the gap between children's competency and that required to successfully complete the step increased. However, the experimenter's uncooperativeness with children's bids for assistance disrupted the association between children's visual attention and the need for assistance. Nonetheless, children in the No Help Group remained more likely to make help-seeking statements as the step difficulty increased.

2.2.8. Accuracy awareness question

The Accuracy Awareness Question, which asked children to assess whether their final product looked like the final picture, was uninformative. While children's performances varied, their assessments of their performances did not: Only two children responded negatively on Sally and none on Sally's House. For both Sally and Sally's House, a binomial test indicated that children evaluated their performances at levels significantly above chance (50%), $p < .001$.

2.3. Discussion

The results provide support for characterizing children's help-seeking as an active information gathering activity. First, the probability of a child seeking assistance on a given step was predicted both by the child's Competency Score and the difficulty of the step in question. Indeed, a statistical model consisting of those two predictors alone matched children's observed probability of seeking assistance remarkably well (Figs. 2A and B). Second, the social dynamic of children's social interactions, that is, the extent to which children were involved in completing the steps, was also predicted by children's competency and step difficulty. This indicates that these two factors not only relate to the occurrence, but also to the action coordination dynamic following children's help-seeking bids. Third, children's competency and step difficulty significantly related to two behaviors children used to initiate assistance. Specifically, children's help-seeking statements and visual attention to the experimenter increased as the gap between children's ability and that required to complete the step independently increased. In sum, we found strong

support for viewing young children's social help-seeking as an information gathering activity, which we discuss further in the General Discussion below.

Lastly, children seemed unaware of the accuracy of their own work. This may be indicative of preschoolers' relatively poor metacognition (Rohwer, Kloo, & Perner, 2012). In this case, children may have had trouble with the fact that they were being asked to reflect upon their own activity. It could also be the case that children simply desired to respond positively (Fritzley, Lindsay, & Lee, 2013), among other possibilities. In any case, it indicated that children are probably not aware of the information gathering aspect of their behavior.

We next investigated whether help-seeking demonstrated any benefit for children's learning. While children's behavior was consistent with our information gathering framework, it was not clear whether children retained any information (i.e., learned) from seeking help. Therefore, in a follow-up visit we assessed whether children demonstrated recollection of the assistance they received on the steps on which they chose to seek assistance.

3. Experiment 1b

3.1. Introduction

In Experiment 1a, we found support for the idea that children's help-seeking may function as an information gathering activity in which children coordinate verbalizations and actions with others when faced with problems they cannot independently overcome.

However, the results of Experiment 1a did not clarify whether children retained any longer term benefit from seeking the experimenter's assistance. Specifically, it was not clear whether children's strategy of initiating social interactions when in need of assistance supported children's longer term learning. For instance, it may be that by seeking the experimenter's assistance children exposed themselves to helpful information that they could themselves apply in the future.

To this end, we obtained some preliminary data in Experiment 1b by asking willing parents to return for a second visit in which children assembled the toys a second time. In this way, we obtained some evidence as to whether children retained the useful information to which they exposed themselves by seeking assistance.

3.2. Method

3.2.1. Participants

At the time of the first visit, parents were asked if they would participate in a second visit exactly a week following the first visit. Willing parents and children were reminded of the second visit via emails and phone calls. Participants who returned for a second visit were 19 children from Experiment 1a (M = 51.60 months, SD = 3.36 months; eleven females). Two children appeared for the second visit but refused to participate.

In addition, one child was forced to leave in the middle of the experiment due to a parental scheduling conflict.

Of the remaining 16 children, 6 who returned for the second visit were from the Help-Seeking Group (Competency Score: $M = 37.42$) and 10 from the No Help Group (Competency Score: $M = 30.66$).

3.2.2. Stimuli and apparatus

The experimental stimuli and apparatus were the same as in Experiment 1a.

3.3. Procedure

For the second visit, each child was seated at the same desk as during the first visit and with the same experimenter. The child was asked to complete the Assessment Toy and then the two Test Toys independently. The experimenter showed the child the final picture of the Boat and asked the child to complete the Boat independently, saying, "You can do this one by yourself by making it look like the picture. Start with the first picture. Each time you need a new picture, just move the picture. Now go ahead and make it look like the picture." As the child completed the Boat, the experimenter expressionlessly watched the child. If the child commented about their progress or asked for assistance, the experimenter said, "Now try to make it look like the picture" and "Remember, you do the Boat by yourself." The experimenter did not provide any corrective feedback. As in the first visit, the child had up to 5 min to complete the Boat.

Following the Boat, each child completed the two Test Toys, Sally and Sally's House, in the same order as in the first visit. The experimenter asked the child to complete the Test Toys independently, saying, "You can do this one by yourself by making it look like the picture. Start with the first picture. Each time you need a new picture, just move the picture. Now go ahead and make it look like the picture." As in the first visit, the child was given as much time as needed to complete the Test Toys. Again, the experimenter responded to entreaties for help by informing the child that they must work independently and try to make it look like the picture.

3.3.1. Coding

Coding for the second visit concerned the accuracy with which children constructed the toys. The same accuracy parameters of Experiment 1a were employed in Experiment 1b. The five accuracy parameters for each step were the following: (1) added the correct number of pieces, (2) made the correct number of connections with those pieces, (3) made the correct type of connection(s), (4) added pieces of the correct color(s), and (5) connected the pieces to the correct part of the existing structure. As in the first visit, for each step children earned from 0 to 5 points; each parameter was worth a minimum of 0 and a maximum of 1 point. Partial credit was given for partial completion. The total score for each toy therefore had a minimum of 0 and a maximum of 5 multiplied by the number of steps. The total possible score on the Assessment Toy, which had 8 steps, was 40. The total possible score on the Test Toys (each with 10 steps) was 50.

3.4. Results

The first analysis concerned assessing whether children performed similarly on the second visit as the first visit. We performed correlation analyses for the Help-Seeking Group and the No Help Group for each of the three toys. For children in the Help-Seeking Group, performance on the Assessment Toy was not significantly correlated for the two visits (Boat: $r(6) = .511$, $p = .150$), and children's performance on both of the Test Toys was significantly correlated (Sally: $r(6) = .850$, $p = .016$, two-tailed; Sally's House: $r(6) = .920$, $p = .005$). Similarly, for the No Help Group, performance on the Assessment Toy was marginally significantly correlated for the two visits (Boat: $r(10) = .457$, $p = .092$), and performance on the Test Toys was significantly correlated (Sally: $r(10) = .910$, $p = .000$, two-tailed; Sally's House: $r(10) = .875$, $p = .000$). These correlations indicated that, except for the Assessment Toy, children's performance on the first visit strongly related to children's performance on the second visit, whether or not children had the opportunity to seek assistance.

The principal evaluation concerned directly evaluating whether children in the Help-Seeking Group retained information from their help-seeking interactions during the first visit. To do so, we needed to assess whether children in the Help-Seeking Group's performance on the steps on which they sought assistance during the first visit was predictive of and similar to their performance on those steps during the second visit.

Two analyses were conducted to assess whether children retained information from their help-seeking interactions. Of the 21 steps on which children sought assistance, their accuracy on the second visit was the same or higher on 16 (76%) of those steps, leaving only 5 steps (24%) on which they performed worse on the second visit. Since children could perform either (a) as well as or better or (b) worse on the second visit compared to the first visit, we performed a binomial test of these two outcomes. Given that we had no reliable information to indicate that children would or would not perform better or worse than their first visit, we set chance at 50% for the two outcomes (i.e., the chances that a child would perform better or worse were set to 50%). A binomial t test confirmed that the proportion of steps on which children performed as well or better on the second visit as on the first visit was significantly greater than expected by chance (50%), $t(20) = 8.00$, $p < .001$. Thus, using performance as a measure of children's recollection, there was evidence that children retained information from the majority of steps on which they sought assistance.

Lastly, we directly assessed whether children's mean accuracy on the steps on which they sought assistance significantly differed across the two visits. A paired samples t test demonstrated that children's mean accuracy on the first visit ($M = 4.90$, $SD = .26$) was not significantly different from children's mean accuracy on the second visit ($M = 4.20$, $SD = 1.78$), $t(20) = 1.78$, $p = .090$. Thus, this analysis provided further evidence that children retained information from seeking help.

3.5. Discussion

Taking into account the small sample size for Experiment 1b, the results provide some initial support for the notion that children's strategy of seeking assistance when in need

of information benefits their learning. Specifically, correlation analyses demonstrated that performance on the first visit related strongly to performance on the second visit for both the Help-Seeking Group and the No Help Group, indicating that children's first experience with the toys related to how they constructed them independently on the second visit. This general relation between performances may simply reflect individual differences. However, analyses specific to the steps on which children sought assistance indicated that children scored as well or better on most of the steps during the second visit and their performance on the second visit did not differ from the first visit. Thus, the results of Experiment 1b indicate that children's help-seeking initiated helpful social interactions with the experimenter from which children learned. Importantly, by examining children's performance on the specific steps on which children received helpful assistance from the experimenter, this analysis excludes the possibility that general individual differences are responsible for the relationship between children's first and second performances. These results and their implications are further discussed in the General Discussion.

4. General discussion

The results of Experiments 1a and 1b provide support for viewing young children's help-seeking as an active information gathering activity that benefits their learning. Specifically, the results of Experiment 1a indicate children's help-seeking relates to the difficulty of the activity and children's competency. First, less competent children were more likely to ask for help than more competent children. Second, as the difficulty of the activity increased, children increasingly chose to seek help. Indeed, a statistical model consisting solely of children's competency and the difficulty of the steps produced probabilities of help-seeking similar to children's observed probabilities. Interestingly, children did not seem aware of their relative accuracy, indicating that children are probably not aware of the information gathering aspect of their behavior.

Moreover, the level of assistance requested (i.e., from asking for verbal reassurance to asking the adult to take over the step) was similarly predicted by the difficulty of the steps and children's competency. Less competent children were more likely to ask for higher levels of assistance, and all children asked for more help when steps were difficult. This indicates that not only the occurrence of help-seeking bids but also the resulting social action coordination relates to children's information gathering. In sum, Experiment 1a provided evidence that children's help-seeking leads to social interactions that support their information gathering (i.e., as outlined in Table 1).

To evaluate whether children's help-seeking did in fact support children's learning, in Experiment 1b a portion of the children returned to assemble the toys independently a week after their first visit. On a significant majority of the steps, children independently reconstructed the steps as accurately as they had with the experimenter's assistance. This indicates children recalled information from the social interactions resulting from their help-seeking bids. Given the small sample size, Experiment 1b therefore provided

suggestive, though not conclusive, evidence that children's information gathering did support their learning. Specifically, the evidence indicates children's help-seeking provided them with opportunities to observe and learn from the experimenter's helpful actions, and children capitalized by learning. Future research should further address this issue by employing follow-up assessments that examine children's learning from independent activity versus activity on which children receive social assistance.

Our results indicate that young children actively engage social resources in a manner that supports their opportunities for learning. Specifically, children flexibly engage adult assistance to the level necessary, not too little nor too much, thereby optimizing their opportunities for learning. That is, whereas on the most difficult steps children both sought help and tended to cede most of the activity to the experimenter, on steps of moderate difficulty children tended to remain actively involved in the interactions following their help-seeking bids. These results nicely complement findings that, from the beginning of life, young learners actively coordinate their attention resources toward stimuli of moderate complexity (Kidd, Piantadosi, & Aslin, 2012, 2014). One interpretation of our findings, therefore, is that young children engaged the amount of assistance necessary to simplify the activity to an acceptably complex form that they could process and engage with.

These findings have implications for current theoretical perspectives of children's independent active learning (Bonawitz et al., 2011; Gopnik, 2012; Schulz & Bonawitz, 2007) and children's early-emerging pro-sociality (Tomasello, 2008; Warneken, Chen, & Tomasello, 2006; Warneken, Gräfenhain, & Tomasello, 2012). Though both perspectives agree that children will sometimes seek assistance, neither currently addresses whether or how young children actively structure social interactions to support learning. Research on children's early-emerging pro-sociality emphasizes children's tendency to engage and cooperate with people in diverse contexts (Tomasello, 2010; Warneken et al., 2006, 2012). From this perspective, children in our experimental paradigm may have been expected to engage with the helpful adult often, regardless of the difficulty of the activity. On the other hand, researchers investigating children's causal and active learning emphasize children's tendency to independently explore their environments and thereby gain learning benefits from such exploration (Bonawitz et al., 2011; Gopnik, 2012; Schulz & Bonawitz, 2007). From this perspective, it is not clear whether difficulty would motivate help-seeking, or instead whether difficulty would motivate further independent exploration. Our finding that young children (at least implicitly) recognize when they need assistance and engage social resources in a manner that reflects their relative need for assistance extends these existing theoretical perspectives, opening new avenues for research. Relatedly, existing computational models of children's learning and inference that emphasize social learning and pedagogy (e.g., Shafto, Goodman & Frank, 2012; Shafto, Goodman & Griffiths, 2014) may be extended in interesting ways if they also include an active, learner-driven component.

Our results also have direct implications for the literature on social scaffolding (Gauvain, 2005; Hammond et al., 2012; van Geert & Steenbeek, 2005; Vygotsky, 1978). In particular, children's help-seeking behavior mirrors effective adult social scaffolding, but

it differs in that it is the help-seeker, not the helper, determining the social dynamic. This indicates that young children are reliable signalers of their relative need for assistance. Importantly, the fact that children effectively structured their social support in our study is consistent with home observation scaffolding research, wherein researchers have found that more than 75% of scaffolding interactions are initiated by children (Carew, 1980; Wells, 1981). Thus, our results suggest that more attention should be paid to the active (and evidently determinative) role of children in scaffolding dynamics.

Importantly, our experimental paradigm was designed to be sensitive to children's help-seeking. Thus, in our experiment the adult was readily available to assist, refrained from interfering unless requested, and always provided helpful assistance. This context does not represent the range of social and academic contexts children experience in their daily lives. The availability and responsiveness of the experimenter may both affect the likelihood of children initiating and sustaining help-seeking interactions. For instance, there is evidence that young children prefer to seek help from reliable sources over unreliable ones (Cluver et al., 2013). Moreover, the helpfulness of the experimenter may impact whether or not the help-seeking interaction provides children with any learning benefit. Thus, future research should modulate the availability, responsiveness, and helpfulness of helpers to assess how these factors impact children's help-seeking and learning.

Relatedly, an interesting question is the extent to which the information gathering framework evaluated in this study relates to children's peer interactions. Unlike children, adults have social status as reliable sources of information for children (e.g., as parents and teachers). Indeed, recent research on children's source monitoring indicates children often prefer adults as sources of information over peers, although children do learn from peers they evaluate as reliable (Duran & Gauvain, 1993; Jaswal & Neely, 2006; Jaswal, Setia, & Cole, 2010). It is possible that children are more likely to seek assistance from an adult than from peers, and from peers they evaluate as reliable over those they do not. Thus, it is important for future research to assess the extent to which information gathering is relevant to children's peer interactions and whether children's peer interactions relate to children's source monitoring.

In addition, our results do not entail that children are explicitly aware of their information gathering. That is, while our results indicate that young children's help-seeking optimizes opportunities for information gathering, they are neutral as to the cognitive, physiological, and developmental mechanisms. For example, it could be that young children simply follow a learned heuristic that they will seek help when they are not independently capable, but otherwise act independently. In this case, children's help-seeking would not be motivated by information gathering at all, but rather by a heuristic that aided them to complete the toy assembly task. Alternatively, and consistent with children's behavior in nonsocial contexts (Bonawitz et al., 2011; Gopnik, 2012; Schulz & Bonawitz, 2007), children may be intrinsically motivated to gather information that supports their learning. According to this perspective, children in our experiment were indeed motivated to gather information about the activity to support their broader learning and engagement with the environment. These opposing explanations indicate that an important

direction for future research is to investigate the cognitive, physiological, and developmental mechanisms that drive young children's social and nonsocial information gathering behavior.

Our results also have implications for the literature on children's developing action coordination and collaboration (Warneken et al., 2006, 2012). Specifically, these results indicate that when children are not able to perform an activity independently they may be more likely to initiate action coordination with others to overcome the challenge. In this way, our research links the literatures on children's help-seeking and collaboration. Notably, commonly used definitions of help-seeking (i.e., signaling to a helper for assistance with a goal) and collaboration (i.e., coordinating actions towards a shared goal) themselves indicate that the behavioral phenomena may be related, as they both involve action coordination and information sharing. However, help-seeking does not always result in balanced collaborative interactions (i.e., interactions in which both parties coordinate actions and share the goal to a similar degree). It is perhaps for this reason that the literatures on help-seeking and collaboration have remained somewhat distinct. Importantly, our results indicate that balanced action coordination is likely to follow certain requests for help, namely those that are initiated by children for whom there is a moderate gap between their competency and that required to complete the activity. Indeed, these particular requests for help may be requests for collaborative assistance specifically, in that both parties are expected to coordinate actions toward the goal more or less equally. Thus, the relative competence of the help-seeker and the difficulty of their goal are important to consider for predicting the collaborative dynamics that follow help-seeking bids.

To conclude, future research on a range of topics related to learning in social environments—including but not limited to social scaffolding, active learning, computational models, and collaboration—should take into account young children's ability and tendency to actively participate in structuring social interactions. When learners are active, they may benefit from teachers who are more receptive. In the right contexts, engaged children may learn best if they simply know that help is available.

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